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(FY91 AASERT) PROCESSES INVOLVED IN THE INTEGRATION OF  
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From 7/93 to 6/94 William Langston and Douglas Kramer continued work on a series of experiments investigating the use of spatial mental models to notice relationships (between objects) that have not been mentioned in a text (the series of experiments headed Experiment 1 in the proposal). From 7/93 to 12/93 the experiments were conducted using sentence reading time as a dependent variable to determine if readers take longer to process a sentence in which the objects referred to in the sentence are far from the locus of attention (in a mental model) compared to when the objects in the sentence are near to the locus of attention. Subjects performed a diagram verification task after reading each text to encourage formation of spatial mental models. From 1/94 to 5/94 the experiments were redesigned to investigate the phenomenon in simpler arrangements (because subjects were not showing a noticing effect in the more complex design). For these experiments, subjects were asked to read texts describing a spatial arrangement of three objects. A manuscript describing the results of these experiments is currently in preparation. Also, this work was reported in Langston, W., Glenberg, A.M. Kramer, D.C. (1994) Mental models are not (very) spatial. Paper presented at the EARLI conference, Helsinki, Finland, June 1994, and in a colloquium given by Arthur Glenberg at the Univ of Minnesota.

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From 7/93 to 5/94 Mr. Langston has also continued research on the use of spatial metaphors in comprehension. In a series of experiments, support was found for the hypothesis that subjects use spatial metaphors (as outlined in Lakoff and Johnson's *Metaphors We Live By*, 1981) to construct representations of text. When texts fail to conform to the culturally appropriate spatial metaphor, aspects of comprehension of that text are adversely affected. This work culminated in Mr. Langston's Ph.D. dissertation. These results were also reported at the 1994 meetings of the Midwestern Psychological Society (Langston, W.E., 1994, Evidence for the use of spatial metaphors when readers comprehend nonspatial texts, Paper presented at the Convention of the Midwestern Psychological Association, May, 1994). In addition, a manuscript reporting the results of these experiments is currently in preparation.

From 8/94 to 12/94 Mr. Langston and Mr. Peter Kruley conducted a follow-up experiment investigating individual differences in subject performance over the course of a semester. Mr. Kruley's subjects read illustrated scientific texts and answered multiple-choice questions that tested their comprehension of these texts (the materials used were drawn from the AFOSR-supported projects reported in the journal article Glenberg & Kruley, 1992). The goal of the experiments was to investigate whether subject performance changes measurably from the beginning to the end of the semester; performance was highly stable across the semester, validating the use of introductory psychology students as experimental subjects. A report of this research (coauthored by Clark Ohnesorge, Peter Kruley, and Steven Haase) was accepted for publication in the peer-reviewed journal *Psychonomic Bulletin and Review* (Langston, W., Ohnesorge, C., Kruley, P., and Haase, S.J., 1994, Changes in subject performance during the semester: An empirical investigation, *Psychonomic Bulletin and Review*, 1, 258-263).

During the current grant period, Mr. Kruley also revised the manuscript published as Kruley, P., Sciamia, S. C. and Glenberg, A. M., On-line processing of textural illustrations in the visuospatial sketchpad: Evidence from dual-task studies, *Memory & Cognition*, 1994, 22, 261-272.

Mr. David Robertson conducted two experiments based on the hypothesis that pictures facilitate comprehension by suggesting mental models. Subjects read texts after being instructed to illustrate the contents of the texts, summarize the content of the texts, or simply study the texts. Although the illustration instruction resulted in marginally better performance than the summarize instruction (supposedly because it encourages construction of a spatial mental model), both were inferior to the simple study instruction. The second experiment follows up on this finding, but the results are not yet completely analyzed.

The Perception, Memory, and Cognition area group in the Psychology Department has certified that Mr. Kramer, Mr. Kruley, Mr. Langston, and Mr. Robertson are making satisfactory progress toward their degrees. Mr. Langston was awarded the Ph.D. on 5/20/94.

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